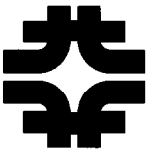

Fermilab

TM-860A
1670.000

CCI Report No. 390-102

Magnet Test Facility

Quench Circuit

Prepared Under Fermilab Subcontract No. 94199
By Cryogenic Consultants, Inc.
Allentown, Pa.

For

Fermi National Accelerator Laboratory, Batavia, Illinois

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MAGNET TEST FACILITY

QUENCH CIRCUIT

The Magnet Test Facility quench system was described originally in CCI Report No. 370-101, 8 November 1977. The report covered the various processes taking place and the concept of a quench circuit. It was based on input supplied by Fermilab on the then latest magnet design. Line sizes were selected based on a particular layout and anticipated flow rates and pressure drops. Later the design was updated, based on larger liquid inventories and the presence of an internal heater on newer magnets.

In brief, the warm quench system is a large buffer volume designed to temporarily store the large volumes of gas generated by a magnet quench. This system accepts the generated fluid, absorbs the fluid refrigeration and slowly meters the generated gas back to compressor suction at a controlled rate. This provides a method for capturing the helium which is normally vented to the atmosphere.

Figure 390-102-1 shows a single magnet tie-in. The system consists of a 4" foam-insulated manifold tied to each of six magnet stand quench lines. The foam insulation prevents personnel injury and exposure to "liquid air rain" when the magnet inventory is ejected into the quench circuit. The 4" line receives magnet fluid from the quench line of the magnet. The magnet is relieved by a yet to be selected relief device, which can be triggered open on a signal which normally precedes a quench.

A portion of the liquid helium contained in the magnet is vaporized by a magnet quench. The gas generated causes pressure to rise, providing a driving force for ejection of the liquid out of the 1Ø lead box. This fluid proceeds through CV119, through the triggered relief device SV157-1, into the 4" quench line manifold. The gas proceeds to the two 1000 gallon propane tanks where it is mixed with gas already in the tank. The cold gas is dumped into the center of the warm tank, providing thorough mixing. The line enters the carbon steel tank through a 27" thermal isolator, thereby preventing localized embrittlement of the carbon steel shell. The combination of heat of compression of the compressing gas, the specific heat of the metal pipe and tanks (in excess of 4000#), allows only a 9° temperature drop for each full quench of 30 liters. The gas is then routed back to compressor suction through PRV158. Should valve MV181 be closed or if the quench tank pressure is not sufficiently reduced by the time a subsequent quench occurs, SV156 protects the tanks at 35 psi -- although for other reasons the tanks and system are good for in excess of 250 psi. The relief assembly shown in the dotted box, SV157-1, is currently envisioned to contain three devices, SV126 (1) which acts as a low pressure ultimate relief in parallel with SV200 (mounted on the magnet at a slightly higher pressure), EV201 (2) the triggered relief device, and MV181 (3), which will allow EV201 to be isolated for warmup prior to a subsequent quench.

This combination of devices allows the magnet system to be fully protected, regardless of a single or multiple operator error. As an

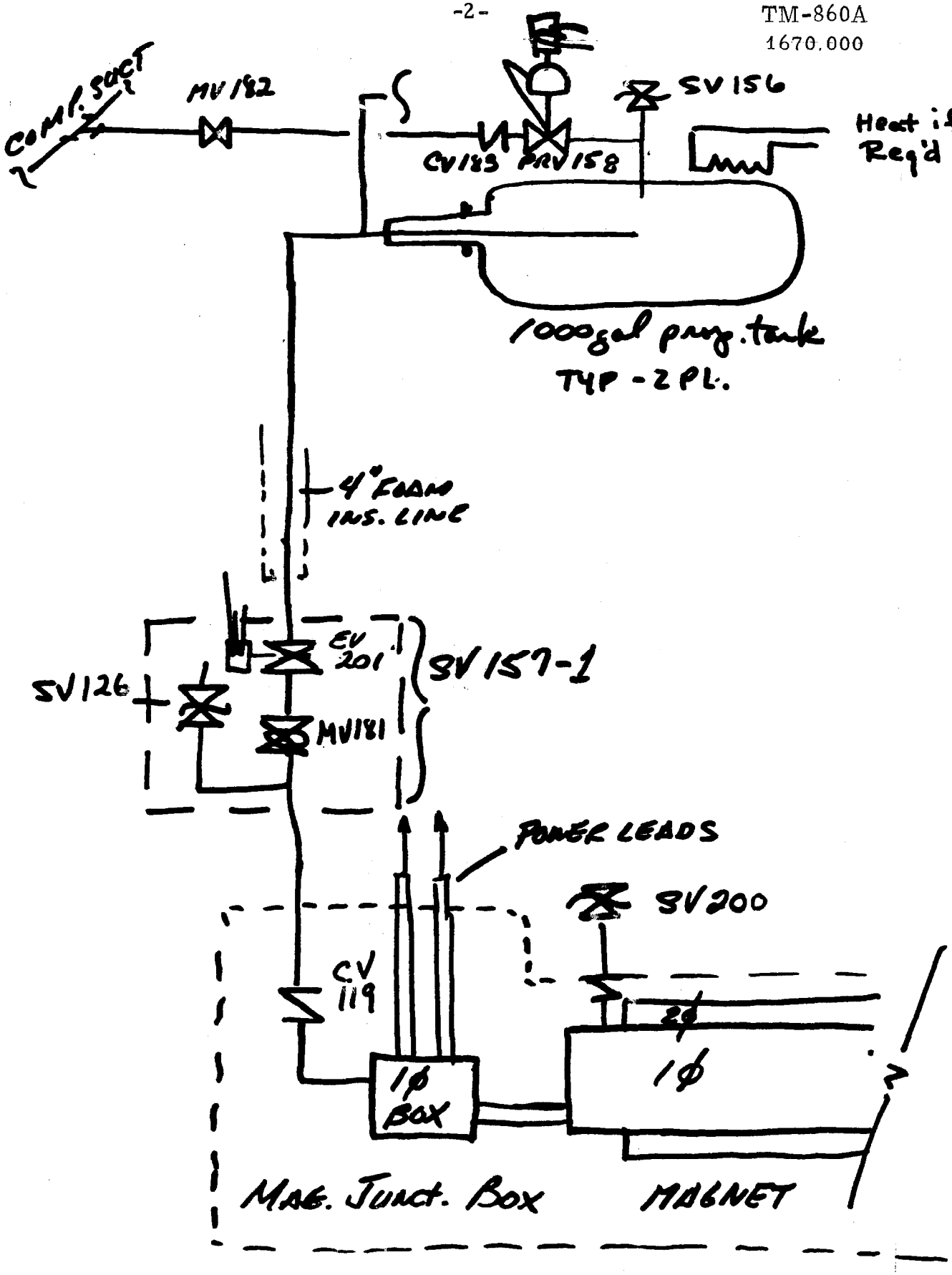

FIGURE 390-102-1

additional measure I would suggest that MV181 be an extended stem, spring-loaded to open ball valve. This would require the valve to be held closed manually for the warmup process. Release of the handle would open the valve, thus replacing EV201 into the system.

PRV158 is a regulator/stop valve combination. The valve is a downstream pressure regulator which will be set slightly above compressor suction. As pressure builds in the quench tanks, the regulator will meter gas to suction to provide the required-to-maintain constant system inventory. This device is equipped with a check valve (CV183) to prevent backflow, and an electrical solenoid which allows the PRV to be overridden (i.e., closed) from a switch in the Control Room.

Once installed the tanks must be monitored for shell temperature and interlocked with PRV158. to prevent cooling of the tanks below shell embrittlement temperature. MV182 is a line block valve in series with PRV158 to allow isolation of the quench system from the refrigerator.

If, during normal operation, it is found that these tanks run cold, a small amount of heat from strip heaters can be added to the shell of the vessels to provide the required heat.

Use of this system will provide a real savings in helium to the Laboratory. The need for purification of raw tube trailer gas should also be diminished.

PROCEDURE FOR INSTALLATION OF MV182 INTO LOW PRESSURE HELIUM HEADER

1. Drop system pressure as low as possible.
2. Provide a positive purge of helium through CV227.
3. The bolts to the spool in the ball valve flanges, which replaced a ball valve on the low pressure line, should be loosened, one bolt removed, and a piece of .060 sheet metal inserted to act as a blind. (See Figure 1.)
4. Retighten the bolts.
5. Cut 1-1/2" line as required.
6. Install Tee/ball valve spool.
7. Weld runs of Tee.
8. Close new ball valve MV182.
9. Increase purge temporarily to sweep purge line.
10. Remove sheet metal block from spool.
11. Retighten bolts on spool.
12. Snoop line for leaks.
13. Remove handle on MV182 to prevent tampering.

FIG 1.

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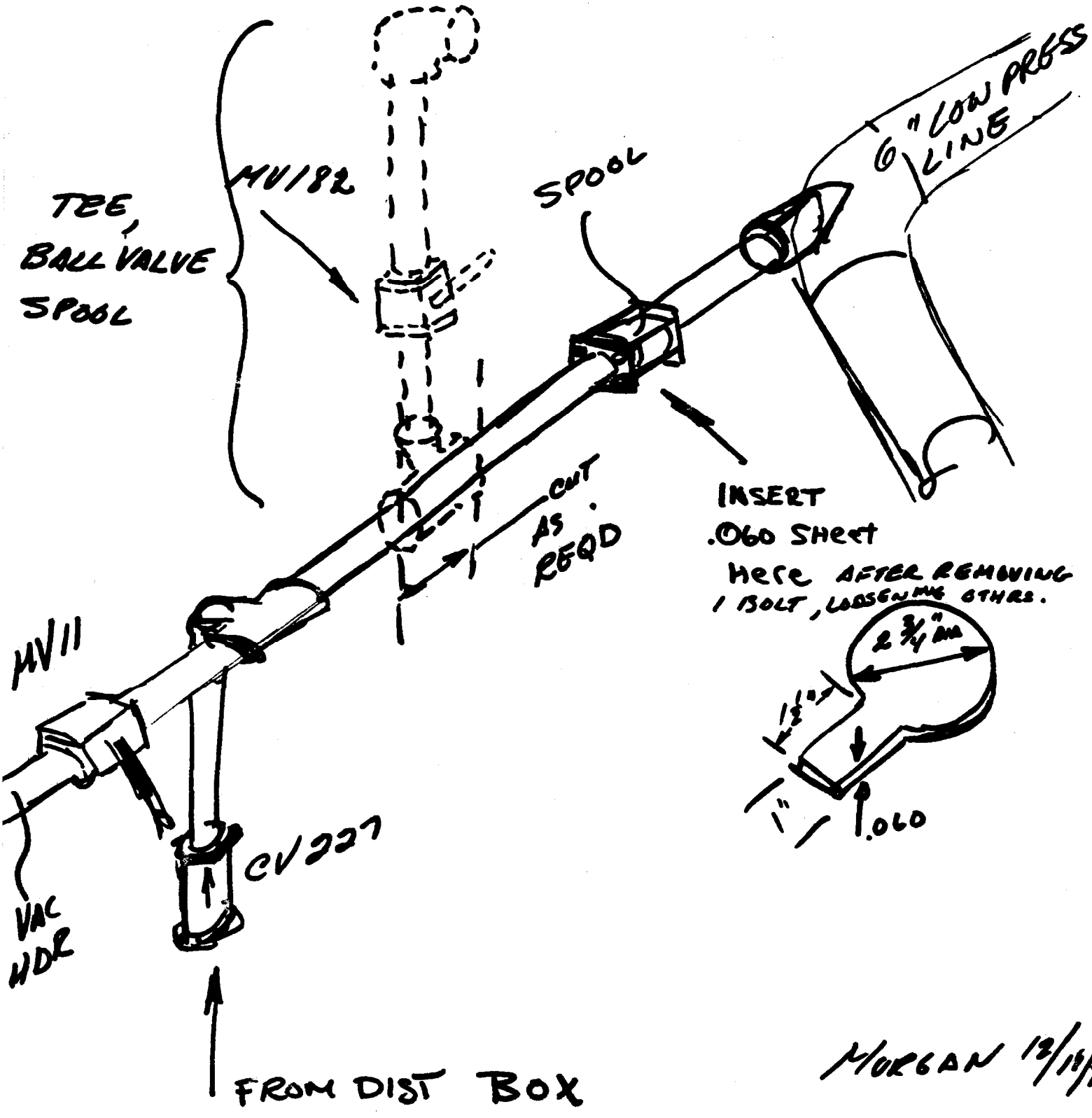
QUENCH CKT. HTF. TIE IN



MORGAN 12/15/76